

REMARKS

In view of the above amendments and the following remarks, reconsideration of the objections and rejections contained in the Office Action of October 2, 203 is respectfully requested.

In order to make necessary editorial corrections, the entire specification and abstract have been reviewed and revised. As the revisions are quite extensive, the amendments to the specification and abstract have been incorporated into the attached substitute specification and abstract. For the Examiner's benefit, a marked-up copy of the specification indicating the changes made thereto is also enclosed. No new matter has been added by the revisions. Entry of the substitute specification is thus respectfully requested.

Upon reviewing the application, it became apparent that original Figure 40 contains a typographical error. Specifically, item "S510" adjacent to the second block from the top of the drawing is incorrect, and should read "S501." Consequently, new formal Figure 40 has been prepared and submitted herewith in order to make only this necessary correction. Thus, no new matter has been added, and the Examiner is respectfully requested to enter new formal Figure 40.

Claims 1-19, 21, and 25-44 are presently pending in this application, and claims 1-13 and 25-39 read on the elected invention of Group I. In this regard, the Examiner has rejected independent claim 1 as being anticipated by the Nonomura reference (USP 6,600,137); has rejected claims 2-5, 8, 9, 13, 25-30 and 36-38 as being unpatentable over the Nonomura reference in view of the Brouillette reference (USP 6,056,191); has rejected claims 10 and 39 as being unpatentable over the Nonomura reference in view of the Brouillette reference and the Fujita reference (USP 6,034,578); has rejected claims 11, 31, and 32 as being unpatentable over the Nonomura reference in view of the Brouillette reference and further in view of the Nakazato reference (USP 5,601,229); and has rejected claims 34 and 35 as being unpatentable over the Nonomura reference in view of the Brouillette reference and further in view of the Arai reference (Japanese reference JP 402203180). In this regard, the Examiner is requested to note that the date listed on the Form 892 for the Brouillette reference, 05-0200, is clearly a typographical error and should be 05-2000. As indicated above, the original claims have been cancelled and replaced with new claims 40-68, and all of the new claims read on the elected invention. Furthermore, although the new claims have been drafted to place the original claims in a preferred form, it is submitted that the scope of the new claims

generally corresponds to the scope of the original claims. Therefore, for the reasons discussed below, the Examiner's prior art rejections are respectfully traversed.

As explained in, for example, page 1, line 23 through page 8, line 13 of the original specification, charge appearance semiconductor substrates (such as piezoelectric substrate wafers, quartz substrate wafers, and compound semiconductor wafers) have an unfortunate characteristic of developing an electric charge due to temperature change during a bump forming operation. Specifically, during the bump formation operation, a significant electric charge may develop, and this electric charge potentially causes pyroelectric breakdown, physical failures such as warpage, cracking, and chipping, and undesirable sparking. In view of these problems, the present invention provides a bump forming apparatus that is specifically designed to remove and eliminate electric charge developed by the charge appearance semiconductor substrate during bump formation caused by temperature change. Specifically, the bump forming apparatus of the present invention comprises a bump forming head, a heating and cooling apparatus operable to cool the charge appearance semiconductor substrate *in a manner to eliminate the electric charge*, and a controller operable to control the heating and cooling apparatus so as to cool the charge appearance semiconductor substrate *in a manner to eliminate the electric charge* (see page 33, line 20 through page 34, line 16 of the original specification). As a result, the undesirable effects caused by electric charge build-up can be avoided.

The Nonomura reference relates to a reflow apparatus for bonding an electronic component to a circuit board by heating a solder, but does not disclose or suggest a bump forming head for forming bumps onto electrodes of a circuit. Furthermore, the Nonomura reference does not disclose or suggest a heating and cooling apparatus operable to cool a substrate in a manner *to eliminate the electric charge*, or a controller operable to control the heating and cooling apparatus in the manner *to eliminate the electric charge*. In this regard, the object to be heated by the device of the Nonomura reference is an electronic component and a circuit board, rather than a charge appearance semiconductor substrate which has the particular problems concerning developing an electric charge as discussed above. In fact, there is no discussion in the Nonomura reference regarding electric charge or removal thereof. Therefore, because the development of an electric charge is not a concern with regard to the device of the Nonomura reference, it is submitted that the Nonomura reference

does not even *suggest* a heating and cooling apparatus or a controller operable as recited in new independent claim 40.

The Brouillette reference is directed to a method and apparatus for forming solder bumps. However the Brouillette reference also does not disclose a heating and cooling apparatus operable to cool a charge appearance semiconductor substrate in a manner so as *to eliminate an electric charge*, or a controller operable to control the heating and cooling apparatus to cool the charge appearance semiconductor substrate in the manner *to eliminate the electric charge*. As explained in column 11, lines 16-31 and illustrated in Figure 8, the Brouillette reference teaches that unfilled mold plates (not charge appearance semiconductor substrates) are conveyed on moving belts 94 so as to be heated and cooled to form filled molds 104. Because of the differences between mold plates and charge appearance semiconductor substrates, the development of electric charges is not a concern in the Brouillette reference and, in fact, is not even discussed in the reference. Thus, it is submitted that the Brouillette reference does not even *suggest* a heating and cooling apparatus and a controller operable in a manner to eliminate electric charge as recited in new independent claim 40.

The Fujita reference discloses a method of forming a surface acoustic wave device, and the Examiner asserts that this reference teaches a contact member for grounding a substrate. Although column 3, lines 40-47 of the Fujita reference teaches that electric charges can be coupled with ions in the air so as to be discharged, or can be discharged through a metal portion near a dicing margin portion, the Fujita reference does not disclose or suggest a heating and cooling apparatus operable to cool a charge appearance semiconductor substrate *in a manner to eliminate the electric charge*, or a controller operable to control the heating and cooling apparatus so as to cool the charge appearance semiconductor substrate *in the manner to eliminate the electric charge*. As explained above, the Fujita reference teaches removal of electric charge by ions or by metal contact, but does not even suggest a component operable to eliminate electric charge from a substrate by controlling cooling of the substrate.

The Nakazato reference discloses a method and apparatus for attaching solder balls to electrodes of a workpiece. The Examiner asserts that the Nakazato reference teaches a bump forming apparatus that includes an ion generator 55. As explained in column 6, lines 52-55 of the

Nakazato reference, an ionizer 55 blows ions toward a pickup head 2 so as to neutralize charges on the solder balls 14. However, the Nakazato reference also does not disclose or suggest a heating and cooling apparatus operable to cool a charge appearance semiconductor substrate *in a manner so as to eliminate an electric charge*, or a controller for controlling the heating and cooling apparatus in a manner so as to eliminate the electric charge. In fact, the Nakazato reference does not even suggest controlling temperature to eliminate electric charge.

The Arai reference is directed to a cooling apparatus including a heat sink having far-infrared ray radiating paint on at least on surface of the heat sink. However, the Arai reference does not disclose or suggest a heating and cooling apparatus that is operable to cool a charge appearance semiconductor substrate *in a manner to eliminate an electric charge*, or a controller operable to control the heating and cooling apparatus to cool the substrate so as to eliminate the electric charge.

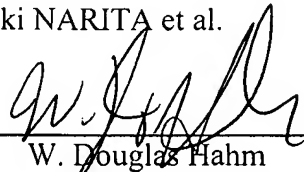
As explained above, the Nonomura reference, the Brouillette reference, the Fujita reference, the Nakazato reference, and the Arai reference do not, either alone or in combination, disclose or even suggest a heating and cooling apparatus operable to cool a charge appearance semiconductor substrate *in a manner so as to eliminate an electric charge*, and a controller that is operable to control the heating and cooling apparatus so as to cool the charge appearance semiconductor substrate *in a manner so as to eliminate the electric charge*. Therefore, one of ordinary skill in the art would not be motivated to modify or combine the references so as to obtain the invention recited in new independent claim 40. Accordingly, it is respectfully submitted that new independent claim 40 and the claims that depend therefrom are clearly patentable over the prior art of record.

In view of the above amendments and remarks, it is submitted that the present application is now in condition for allowance. However, if the Examiner should have any comments or suggestions to help speed the prosecution of this application, the Examiner is requested to contact the Applicant's undersigned representative.

Respectfully submitted,

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